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POWDER METALLURGY

Powder metallurgy is the art of forming metal objects by the compression and sintering of metal powders instead of by conventional practices of melting, casting, hot- and cold-working, and machining to shape. Its first practical application was in the fabrication of tungsten, the high melting point of which precludes melting and casting in any known crucible or mold. For years it remained a specialized process limited to a few metals which could not be fabricated by ordinary methods. Later it was realized that powder metallurgy has useful applications for common metals, and the development of special bearings greatly stimulated the powder metallurgy industry. These bearings, made of common metal powders, are valuable for their "oil-less" properties, which depend upon their controlled porosity. Other developments in powder metallurgy have been along several lines, for example, the production of "alloys" which cannot be made by foundry methods (tungsten-tin, copper-graphite, etc.), and of small parts which require undue

amounts of machining when made by conventional methods.

In general, articles produced by powder metallurgy are individually small in size, but the aggregate of all these small parts, particularly under the impetus of the war effort, amounts to an appreciable industry. However, most of these successful applications have been developed by "cut and try" methods; fundamental data are incomplete, and the interrelation of the different factors in the process is not well understood.

Personnel limitations have hitherto prevented the Bureau from conducting investigations in powder metallurgy, but work along these lines is now being started under the direction of J. G. Thompson. The initial work will consist in a study of commercial metal powders to determine for each powder its characteristic average size and shape, the particle-size characteristics as determined by various means, and the density and other pertinent properties. Information on the effect of temperature and pressure in the compacting operation is needed, and likewise the effects of time, temperature, and atmosphere of

¹ Published with approval of the Director of the Budget.

the sintering operation. Individual metal powders will be studied at first; mixtures of two or more metals and mixtures of metals and nonmetallic powders will follow.

In preparation for the experimental work, a supply of metal powders and some necessary equipment have been purchased, other equipment has been and is being designed for shop construction, and the literature is being reviewed for available information on powder metallurgy.

STRESS-CORROSION TESTS OF BRIDGE-CABLE WIRE

The September Journal of Research contains a paper (RP1604) by R. E. Pollard describing stress-corrosion tests on a limited number of samples of cold-drawn Portsmouth (Ohio) Bridge wire as well as a few samples of heat-treated Mt. Hope (Rhode Island) Bridge wire and the cold-drawn wire that replaced it. These tests were carried out primarily for the purpose of reproducing, if possible, service failures of the Portsmouth Bridge wire, which previously had been tentatively attributed to stress-corrosion.

Stress-corrosion cracks developed in specimens of Portsmouth wire and the heat-treated Mt. Hope wire when immersed under stress in dilute solutions of ammonium nitrate and sodium nitrate. No cracks were produced in the cold-drawn Mt. Hope wire. No cracks were produced by immersion of similar specimens in more corrosive solutions, such as distilled water or dilute ammonium sulphate, or in inhibitive solutions such as ammonium nitrite or sodium hydroxide.

The results conform, in this respect, to the selective corrosion theory of intercrystalline attack. However, due to the limited amount of materials and their incompletely known history, the effect of such factors as composition, fabrication, and heat treatment of the steel could not be determined.

SOIL CORROSION OF PIPE LINES

In 1922, the Bureau started a study of the corrosion of pipe lines in typical soils throughout the United States. The results obtained early in this investigation showed that in many soils the damage by corrosion was much greater than had been anticipated, and that no ordinary pipe material could be expected to give satisfactory service under these conditions. In order to improve this situation, manufacturers of pipe materials

commenced the development of products suitable for use in corrosive soils, and about 1932 the Bureau began a supplementary investigation intended primarily to assist manufacturers in determining how well the problem had been solved.

Instead of attempting to secure all the specimens that would be needed if systematic data on the effect of individual alloying elements or their amounts were to be obtained, manufacturers were invited to submit materials on which they desired information. Furthermore, the specimens were buried under simulated practical conditions so that accurate technical control was not feasible. Also, since very few specimens of each type were included, dispersion of the data resulting from the general conditions of the tests makes it impossible to draw very definite conclusions with regard to the comparative merits of the several materials investigated. Nevertheless, the data do give a general indication of what may be expected of a considerable variety of alloys when exposed to severe soil conditions. The addition of very small percentages of alloying elements does not have a marked effect on the rate of corrosion, but rather large percentages are apt to bring about a considerable improvement in corrosion resistance.

Steels high in nickel and chromium, and copper alloys high in copper are very resistant to nearly all soil conditions. Lead corrodes only slightly after it acquires a coating of an insoluble lead salt.

Bursting and crushing tests indicate that asbestos-cement pipe gained some what in strength during exposure to the soil for 4 years.

A 3-ounce coating of zinc added about 3 years to the life of steel exposed to some of the most corrosive soils in the test sites. Lead coatings appear to be inadequate for severe soil conditions.

Several thick experimental coatings prevented practically all corrosion at most of the test sites for 9 years. Air-dried Bakelite coatings blistered within 4 years, and baked-on Bakelite coating blistered in a few places; otherwise it showed no change in appearance after this length of service. Pitting occurred under some of these blisters. Most thin coatings blistered, became brittle, and permitted rusting and pitting of the metal to which they were applied within 4 years.

The latest progress report on the soil-corrosion work will appear as RP1602 by Kirk H. Logan and Melvin Romanoff in the September number of the Journal of Research.

COOPERATION WITH CAST-IRON-PIPE RESEARCH ASSOCIATION

While the results of the Bureau's soil-corrosion studies have had important applications in a number of war projects, it appears best to postpone new experimental field work until manpower and travel conditions improve. Most of the laboratory staff have gone into military service or have been assigned to special war problems in other fields. In the interest of maintaining some of the work, the Cast Iron Pipe Research Association has established a Research Associateship at the Bureau, and has engaged Kirk H. Logan to fill this position. Mr. Logan is retiring from the Bureau staff after 33 years of service, including nearly 20 years as head of the underground-corrosion section. For the present, his assignment is to advise the cast-iron pipe industry on measures directed toward making its product more resistant to corrosion, and to carry on the development of means for reducing or eliminating corrosion in areas where it is serious.

ANCHORAGES FOR REINFORCEMENT IN CONCRETE

In designing reinforced concrete structures, it is ordinarily assumed that the tensile and compressive deformations in the steel reinforcement are the same as in the adjacent concrete. To assure an approximation of this common action of the two materials, the design stresses in the reinforcement and the bond stresses between the concrete and the reinforcement are limited to values indicated to be safe by the results of laboratory tests and experience. Often, the necessary anchorage for the reinforcement is obtained by bending the ends of the bars to form semicircular hooks. Current specifications limit the radii of such hooks and their lengths beyond the point of curvature, but they do not include effective requirements governing the surface texture and the nature of the deformations on deformed bars. In an investigation of the factors that influence the effectiveness of hooks as anchorages for reinforcement, it has been found that the deformations on the bars have a greater effect upon the performance of hook anchorages than any of the factors now limited in specifications. The results of the investigation provide information on which to base specifications for anchorages that require less steel and are more likely to function as intended than those now in common use.

INSTRUMENT FOR DETERMINING AIRWORTHINESS OF FABRICS

A test and calibration program has been conducted by the Bureau on a new mechanical fabric tester developed by the Civil Aeronautics Administration. This work has resulted in the refinement of the instrument, which determines the airworthiness of doped fabric aircraft covering. It is expected that this mechanical method will supplant the method in which the inspector judges airworthiness by his ability to push his thumb through the fabric.

The instrument operates on the same principle as the automatic center punch. The foot of the instrument is held against the surface to be tested and a steadily increasing pressure is applied, thus compressing a "firing" spring. When the spring has been compressed a predetermined amount, it is released by an automatic trigger and drives a hammer against a plunger which impinges upon the surface being tested. The energy of impact is obtained by measuring the indentations produced in a block of lead.

In studying the instrument, test panels were prepared from different weights of cloth, both new and chemically deteriorated to known extents, and coated with good, semibrittle, and very brittle dope in different amounts. Impact tests were made on all panels while in equilibrium with air having a temperature of 73° F and a relative humidity of 50 percent, and on some panels while at temperatures of -40° and +160° F.

The impact energy required to drive the plunger through cloth coated with good or semibrittle dope at 73° F correlated well with the breaking strength of the doped cloth. Doped cloths became stronger and more resistant to penetration by impact as the weight of the dope increased. Very brittle dope was readily detected by ringworming caused at low impact energy. Tests of fabrics at -40° and +160° F showed the value of the instrument for studying the changes in doped cloths with temperature. Cloths coated with both good and semibrittle dope became very brittle at -40° F and were penetrated at low impact energy. The cloths coated with semibrittle dope became pliable at +160° F, and more impact energy was needed for penetration than at 73° F.

Twelve of the instruments have been designed and built by the technical development division of the Civil Aero-

nautics Administration and calibrated in the textile section of the Bureau. These have been distributed to interested organizations in order to obtain comments from field inspectors with regard to the instrument and its use in detecting unairworthy fabric coverings on airplanes.

FLOWMETER FOR OXYGEN REGULATOR TEST SETS

The safety of aviators flying above 20,000 feet depends upon proper functioning of aircraft oxygen regulators. This can only be ensured by periodic checking with special testing equipment. At the request of the Bureau of Aeronautics of the Navy Department, the Bureau has developed a readily portable field test set so that this necessary checking can be carried out at any landing field. With the great increase in the number of planes in service there has been an urgent demand from both the Army and the Navy for these sets.

Accurate flowmeters to measure the rate of flow of oxygen, or oxygen and air mixtures, are essential parts of each unit. Originally, a commercial flowmeter known as a "rotameter" was used, but when bids were asked for quantity production of the test sets it was found that the demand for the rotameters for other essential uses was such that deliveries of the sets might be delayed for months. Development work was, therefore, rushed on a flowmeter of a new type that could be manufactured easily and quickly from noncritical materials, and which has proved to be even better for the purpose than the rotameters previously used. This "National Bureau of Standards Flowmeter" is simply a can of tightly packed glass wool through which the oxygen or air flows. The pressure difference between the ends of the can, measured by a differential gage, is directly proportional to the flow. The final designs of this flowmeter were furnished to the manufacturer, and the field test sets in which it is included are being calibrated at the Bureau as rapidly as they are produced.

BIBLIOGRAPHY OF SOLID ADSORBENTS

The scientific literature in the field of technical adsorbents is wide in scope, and its sources are correspondingly extensive and varied. This is the result of many factors, including recent progress in fundamental chemistry. Industry has made its contributions, in par-

ticular the sugar refining industry which, since the early decades of the nineteenth century, has offered a potential market for any newly proposed adsorbent; in fact, competition for this field has contributed in no small degree to the development of adsorbents in general. The automobile industry has been indirectly responsible for the greatly increased use of clays and earths, because it was the demand of this industry for improved fuels and lubricants that resulted in the recent advances in petroleum refining, where these and similar adsorbents are so important. The rapid growth and complexity of processes in the organic chemical industry have necessitated the use of solvent-recovery adsorbents, and in this role, activated charcoal has made available large volumes of expensive solvents. In a recent development, moisture adsorbents are employed on a large scale in packaging materials for shipment or storage, thus preventing damage by corrosion, mildew, and mold.

This elaborate scientific literature has been assembled by Victor R. Dietz, research associate at the Bureau, and has just been privately published in a book of 958 pages entitled: "Bibliography of Solid Adsorbents." A better conception of the contents may be had from the subtitle: "An annotative bibliographical survey of the scientific literature on bone char, activated carbons, and other technical solid adsorbents for the years 1900 to 1942, inclusive." The work incident to the publication was conducted under the joint sponsorship of the United States Cane Sugar Refining Industry and the Bone Char Manufacturers on the one hand, and the National Bureau of Standards on the other. The book is obtainable at \$12.00 a copy from its publishers: United States Cane Sugar Refiners Research Project, J. M. Brown, Chairman, Revere Sugar Refinery, 333 Medford Street, Charlestown 29, Mass.

There are 6,002 literature references, and an abstract is given for each of these. The volume is divided into seven chapters: I. Adsorption of gases and vapors on solid adsorbents; II. Adsorption from solutions on solid adsorbents; III. Thermal effects in adsorption processes; IV. Theories of adsorption; V. Refining of sugars and other applications of adsorbents; VI. General information on adsorbents and special methods of investigation; VII. Preparation of carbon adsorbents. Each chapter has numerous subdivisions and the literature is entered chronologically (alphabetically within any particular year). There are complete author and subject

indexes, the latter being designed for cross-indexing utility. A complete tabulation is given of the abbreviations used for the journal references. The sources of the bibliography are tabulated in full and include a list of books dealing with the subject of adsorption.

An original account is presented of the history of commercial adsorbents in relation to the sugar refining industry. This has been prepared from older data obtained from original publications and from present-day information furnished by the various industries. A valuable feature is the tabulation of the commercial solid adsorbents, presented in three groups: Carbon adsorbents in the United States; Foreign carbon adsorbents; Non-carbon adsorbents in the United States.

This volume should fill the need of a ready reference source to the extensive and widely scattered modern literature on adsorption.

EFFICIENCY OF DRYING AGENTS

The September number of the *Journal of Research* contains a paper (RP 1603) by John H. Bower on the efficiency of commercial drying agents. This is a revision of RP649 by the same author, and gives new values for two of the desiccants included in the original paper (BS J. Research 12, 241; February 1934). It is of interest to note that these new values for silica gel and aluminum trioxide (which were different grades from what had been used in the original work) showed greater efficiency than the original materials. The residual water per liter of moist air passed through silica gel was found to be 0.006 mg and through the alumina was 0.001 mg.

DRY CELLS AND THEIR RAW MATERIALS

Because of the war, batteries have been put to new uses under extreme conditions. This has encouraged research on dry cells and their raw materials. Howard F. McMurdie of the Bureau has prepared a report for the Transactions of the American Electrochemical Society concerning the crystalline products formed during discharge of the cells and identification of the various MnO_2 minerals in the ores used as raw materials. X-ray and electron diffraction studies indicated that five varieties of MnO_2 or closely related compounds occur in battery oxides. These are pyrolusite, ramsdellite, cryptomelane, γ - MnO_2 and δ - MnO_2 . The last two are poorly crystallized. Electron micrographs showed

that the particle size and shape vary greatly between different oxides.

Prismatic crystals of $Zn(NH_4)_2Cl_2$ are formed in the paste of undischarged cells after some aging, whereas small hexagonal plates of $ZnCl_2 \cdot 4Zn(OH)_2$ are found in the pastes of discharged cells.

After discharge, the manganese in a cell was found to be largely in the form of $ZnO \cdot Mn_2O_3$ (heterolite). This indicates that of the oxygen in MnO_2 only one-fourth is available for depolarization in dry cells.

MAINTENANCE OF RADIATION STANDARDS

Thirty years ago the Bureau's radiometry section established a standard of thermal radiation in the form of a 40-watt, 115-volt carbon-filament lamp calibrated against a blackbody, for use in standardizing thermopiles and other nonselective radiometers employed in measuring weak sources of radiation. The demand for these lamps has exceeded expectations; over 300 of them have been issued during the past 25 years.

Recently the section prepared a more powerful standard source of thermal radiation in the form of a 1,000-watt monoplaner, tungsten-filament lamp for use in calibrating similar high-powered lamps that serve as the working standards of manufacturers of "infrared-ray" drying lamps extensively used in industry. During July these high-powered radiation standards were recalibrated and placed on a more reliable basis; also some of the 40-watt standards (the Bureau has a group of 33 of these lamps that are used to maintain the standard) were checked by W. W. Coblenz and C. J. Humphreys.

In addition to these two standards of thermal radiation, the section maintains: (1) a "cold quartz" mercury-arc standard for calibrating ultraviolet-intensity meters used in measuring the output of ultraviolet germicidal lamps for disinfecting the air in hospitals, etc.; and (2) a "hot quartz" mercury-arc lamp standard for calibrating dosage intensity meters that are used to measure the output of ultraviolet therapeutic lamps.

In this connection, it is of interest to note that the Bureau was the pioneer in establishing a standard of radiation, which has found favor in distant countries (e. g., New Zealand) and has formed the nucleus for similar standards maintained in the national laboratories of England, various countries of

Europe, and recently in Australia. These standards are of great value in standardizing light stimuli used in physiology, biology, and especially photochemistry.

SELF-IGNITION TEMPERATURE OF LIQUIDS

The fact that the temperatures at which combustible liquids will take fire

spontaneously depends greatly on the conditions surrounding the liquid, has been generally overlooked. Realizing that the size of the flasks used for ignition tests is a matter of importance, experiments were made recently at the Bureau to determine the effect of size of flask on self-ignition temperature. The results for three sizes of flasks have been correlated, and typical values are as follows:

Liquid	Size of chamber								
	200 ml			1,000 ml			15,000 ml		
	Temp.	Lag		Temp.	Lag		Temp.	Lag	
	° C	min	sec	° C	min	sec	° C	min	sec
Carbon bisulfide.....	110	0	08	110	0	14	96	0	20
Kerosine.....	233	1	30	227	2	15	215	6	00
Motor gasoline.....	248	2	30	243	4	30	240	8	15
Ethyl alcohol.....	402	0	28	390	0	40	369	1	08

It is seen that the ignition temperature decreases with increase in size of the ignition chamber, and also that the lag between the time the sample is introduced and ignition occurs, increases with chamber size. Apparently these are attributable to the better conditions for self-heating that obtained with the larger ignition chambers.

TRANSFORMATIONS OF THE FUNDAMENTAL EQUATIONS OF THERMODYNAMICS

The existence of symmetry relations between certain sets of thermodynamic formulas has been recognized since the researches of Willard Gibbs. Nevertheless, Koenig seems to have been the first to exhibit these relations in the compact form of a substitution group on the thermodynamic functions E , H , F , G , and the variables of state V , S , T , μ , N . Although Koenig did not give a derivation of the characteristic group, he did show how it can be generated from the symmetry properties of a square. In the September Journal of Research (RP1605), Floyd Buckley of the Bureau's physical chemistry section, gives a derivation that is based upon the transformation properties of a "group of functions" under a contact transformation.

The general thermodynamic behavior of a system can be conveniently described in a given representation with the aid of a characteristic function and three auxiliary functions defined in terms of the characteristic function and its partial derivatives. The four representations correspond to the following

pairs of independent physical variables: (V , S), (P , S), (V , T), (P , T). There are four contact transformations (including the identity) associated with each representation, each transformation being defined by one of the auxiliary functions which plays the role of a Legendre function in a cylindrical tangential transformation. The auxiliary functions constitute a "group of functions" which is transformed under the contact transformations into equivalent groups in the remaining coordinate systems.

If the matrix of coefficients of resolutions of the "group of functions" characteristic of a given representation is taken as the fundamental form of representation of the group, then it is found that this form is invariant under the four contact transformations that transform to the other representations. The characteristic contact transformations can be regarded as linear transformations on a "space" of four variables (two independent and two dependent) and as such are found to be simple permutation transformations. These permutations constitute a group which can be generated from the properties of the square.

The fundamental form of the characteristic "group of functions" in a given representation remains invariant under the associated contact transformations without algebraic rearrangement, provided the functions of the group themselves undergo a simple permutation. These permutations also constitute a group, and can be generated from the symmetry operations on the square. The "space" on which this group operates

consists of the characteristic function and the three associated auxiliary functions.

The "spaces" of the permutation groups for the thermodynamic functions and the physical variables of state are mutually exclusive, and since the two groups are isomorphic, they can be combined into a single group which operates on the combined spaces of the individual groups. The matrix of the characteristic form of the "group of functions" in a given representation is invariant under this resultant substitution group G^* .

There are four contact transformations associated with each representation. These transformations are equivalent and from them families of equations invariant under G^* can be selected. Other families can be found among the transformation formulas of the higher derivatives.

Formulas deductible by simple operations, e. g., differentiation, on the characteristic group of functions of a given representation provide basic forms for families invariant under the group G^* . The number of members in a family is 1, 2, 4, or 8.

NEW MATHEMATICAL TABLES

Two more mathematical tables, in the form of reprints from the Journal of Mathematics and Physics, have been added to those obtainable from the Bureau. These are

MT28. Table of $f_n(x) = \frac{n!}{(x/2)^n} J_n(x)$.

MT29. Tables of coefficients for inverse interpolation with advancing differences.

The price of each of these is 25 cents a copy. A list of the tables prepared by the Mathematical Tables Project (originally under the Work Projects Administration, and now directed by the Bureau), which includes not only the tables obtainable from the Bureau but those available elsewhere, will be sent on request. Correspondence should be addressed to the Information Section, National Bureau of Standards, Washington 25, D. C.

COMMERCIAL STANDARD FOR MARKING SILVER JEWELRY

The National Stamping Act of 1906 sets forth tolerances for items marked "Sterling", "Sterling Silver", "Coin", "Coin Silver", or with the actual fineness; but it fails to set forth exemptions not to be included in any assay for quality, such as screws, rivets, springs, and other elements of construction that

are generally considered by the trade as necessarily being of other materials in order to give adequate service in the hands of the user.

The words "silver" and "solid silver" have, as a matter of trade usage, come to mean sterling silver, unless otherwise indicated. In order that these practices and usages might become a matter of public record and acceptance on a Nation-wide basis, the New England Manufacturing Jewelers' and Silversmiths' Association requested the Bureau's cooperation in establishing a commercial standard for marking jewelry and novelties of silver, exclusive of flatware, hollowware, and toilet ware.

As a result of these efforts, such a commercial standard has just been released. It was developed, adjusted, and accepted by all those directly concerned, including producers, distributors, users, and testing laboratories. It bears the title, Marking of Jewelry and Novelties of Silver, Commercial Standard CS118-44, and is available from the Superintendent of Documents, Government Printing Office, Washington 25, D. C., at 5 cents a copy.

The standard sets forth the accepted definitions, requirements for quality marks, recognized exemptions, and requires that in order to fix responsibility, quality marks shall be accompanied by the name or trade mark of the manufacturer or seller, duly applied for or registered under the laws of the United States. Tolerances under the standard are the same as those provided by the National Stamping Act, and an excerpt of these tolerances is included as a matter of information.

ACHESON MEDAL AND PRIZE AWARDED TO WILLIAM BLUM

Notice has been received from the Board of Directors of the Electrochemical Society that the eighth Edward Goodrich Acheson Medal and \$1,000 prize have been awarded to William Blum, chief of the Bureau's electrochemistry section, for his outstanding accomplishments in the field of electrodeposition. The formal presentation ceremonies will be held at the convention of the Society in Buffalo on October 13. Dr. Blum joined the Bureau's staff in 1909 and for several years was engaged in analytical work, including the use of sodium oxalate as a primary standard in volumetric analysis, the titration of manganese, and the gravimetric determination of aluminum. Beginning about 1913, he commenced his investigations in electrochemistry, a subject which has since occupied most of his time. As chief of the electro-

chemistry section, he has had charge of many projects in electroplating and electrolyzing. He has maintained particularly close and cordial relations with industry and has directed the work of numerous research associateships. Dr. Blum has made important contributions to military applications of electroplating and to the conservation of critical materials.

The Edward Goodrich Acheson Medal and Prize were founded by Dr. Acheson in August 1928. The award is made once every 2 years to the "person who shall have made a distinguished contribution to the advancement of any of the objects, purposes or activities of the Society."

NEW AND REVISED PUBLICATIONS ISSUED DURING AUGUST 1944

Journal of Research²

Journal of Research of the National Bureau of Standards, volume 33, number 1, July 1944 (RP1592 to RP1596, inclusive). Price 30 cents. Annual subscription, 12 issues, \$3.50.

Research Papers²

[Reprints from the June 1944 Journal of Research]

RP1588. Purification of substances by slow fractional freezing. Frank W. Schwab and Edward Wichers. Price 5 cents.

RP1589. A study of the properties of household blankets. Herbert F. Schiefer, Hazel Tharp Stevens, Pauline Beery Mack, and Paul M. Boyland. Price 10 cents.

RP1590. Studies of portions of the quaternary system soda-lime-silica-water at 25° C. George L. Kalousek. Price 10 cents.

RP1591. Laminar flow at the interface of two liquids. Garbis H. Keulegan. Price 10 cents.

Simplified Practice Recommendation²

R3-44. Metal lath (expanded and sheet) and metal plastering accessories. (Supersedes R3-41.) Price 5 cents.

Commercial Standard²

CS118-44. Marking of jewelry and novelties of silver. Price 5 cents.

² Send orders for publications under this heading only to the Superintendent of Documents, Government Printing Office, Washington 25, D. C. Subscription to Technical News Bulletin, 50 cents a year; Journal of Research, \$3.50 a year (to addresses in the United States and its possessions and in countries extending the franking privilege); other countries, 70 cents and \$4.50, respectively.

Technical News Bulletin²

Technical News Bulletin No. 328, August 1944. Price 5 cents. Annual subscription, 50 cents.

MIMEOGRAPHED MATERIAL

Letter Circulars

[Letter Circulars are prepared to answer specific inquiries addressed to the National Bureau of Standards and are sent only on request to persons having a definite need for the information. The Bureau cannot undertake to supply lists or complete sets of Letter Circulars or send copies automatically as issued.]

LC758. Finishes for concrete floors.

LC759. Thermal insulation of dwelling houses.

LC760. Information on ultraviolet transparency of window materials and fabrics. (Supersedes LC549.)

LC761. Solders and soldering. (Supersedes LC701.)

Weights and Measures News Letter

[Intended primarily for weights and measures officials and manufacturers of weighing and measuring apparatus. No charge is made for this service. All communications should be addressed to the Secretary, National Conference on Weights and Measures, National Bureau of Standards, Washington 25, D. C.]

W&MNL36. Weights and Measures News Letter No. 36. May-June 1944.

RECENT ARTICLES BY MEMBERS OF THE BUREAU'S STAFF PUBLISHED IN OUTSIDE JOURNALS²

Report of the secretary, Horological Institute of America. Ralph E. Gould. J. Horological Inst. Am. (c/o National Bureau of Standards, Washington 25, D. C.) (June 1944).

Bibliography of solid adsorbents. Victor R. Deitz, research associate. Book of 958 pages, published by United States Cane Sugar Refiners Research Project (J. M. Brown, Revere Sugar Refinery, 333 Medford St., Charlestown 29, Mass.) (June 1944).

Effect of curvature on strength of axially loaded sheet-stringer panels. Walter Ramberg, Samuel Levy, and Kenneth L. Fienup. NACA Tech. Note No. 944 (Natl. Advisory Com. for Aeronautics, Washington 25, D. C.) (August 1944) (Restricted).

The development of elevator codes. John A. Dickinson. Natl. Safety News (Natl. Safety Council, 20 N. Wacker Drive, Chicago 6, Ill.) 50, No. 2, 20 (August 1944).

² These publications are not obtainable from the Government, unless otherwise stated. Requests should be sent direct to the publishers.

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